DM-qode Gen1 properties and plastic-part traceability

Marking condition

DM-qode Gen1 from matriq produces a part-specific Data Matrix code onto every plastic part produced. The code is “stamped” or “embossed” onto the part during the forming process inside the mold. The timing of the marking process is triggered by the insert itself, by measuring the mold flow inside the cavity using the integrated temperature sensors of the DM-qode Insert.

12x12 Data Matrix code

DM-qode Gen1 generates 144-pixels Data Matrix codes, a different one on each part. Data Matrix are 2D codes defined according to ISO/IEC 16022 and mainly used by the ECC200 implementation (dealing with error correction). With DM-qode Gen1 a 10-digit number can be encoded: from «0.000.000.000» to «9.999.999.999» (10 billion numbers). The Data Matrix Code example on the right says “1234567890”. For more information, see [(1)].

Marking process parameter

For marking with DM-qode, the operator can set specific parameters using the supplied tablet screen (or alternatively a laptop connected to the DM-LinQ). Marking setup is simplified for the user by setting four parameters: *cycle time*, *marking delay*, *marking duration*, and *target temperature*. These values are set once, stored in the device, and remain constant for a specific mold and polymer. Further information, see [(2)]

Multicavity molds

In a mold tool with several cavities equipped with one DM-qode insert per cavity, each cavity receives its own Data Matrix code. The DM-Controller serves in its current version up to 4 inserts simultaneously. For mold tools with higher cavity numbers, two or more DM-Controllers are needed.

Direct-part marking

DM-qode Gen1 directly marks plastic parts by direct-part marking (DPM) without using any added colors or alike. The code quality assessment is described in the norm ISO/IEC 29158 (also named AIM DPM) and differs in essential aspects to the assessment of 2D codes printed on labeled where the standard according to ISO/IEC 15415 is used.

Generating Code

We have implemented six ways to generate a code on the molded parts (marking patterns):

(1) *count up*: where the code increases by one every cycle starting at a start value

(2) *constant + count up*: a combination of a fixed prefix (consisting of two alphanumeric characters) followed by a six-digit counter (e.g. XY000001, XY000002, XY000003, …)

(3) *constant*: a constant alphanumeric code is written on every part

(4) *random:* where a quasi-random ten-digit number is marked for each component. This mode is primarily suitable for testing purposes and is not recommended for productive series production

(5) *Unix timestamp*: The current timestamp of the marker in UTC time. It is displayed in the format of a 10-digit Unix timestamp (seconds since January 1, 1970, 00:00 UTC). Example: 1747778400 corresponds to May 21, 2025, 00:00:00 UTC.

(6) *user-controlled*: every code to be written is given by a higher-level system at the production site and communicated using the OPC UA interface of the DM-qode system.

Further information, see [(1)]

Reading code

Data Matrix codes “stamped” by DM-qode Gen1 can be read by code reader cameras (preferably DPM-capable and ideally also AI-enhanced cameras) and under appropriate light conditions. It is also possible to read these codes using phone cameras, preferably using the Scandit app. Further information, see [(1)]

Use Cases

DM-qode Gen 1 is designed for traceability to improve data-driven quality control. Every produced part is marked with a unique 10-digit number to which all material and production process information are associated in a database hosted locally or in a cloud.

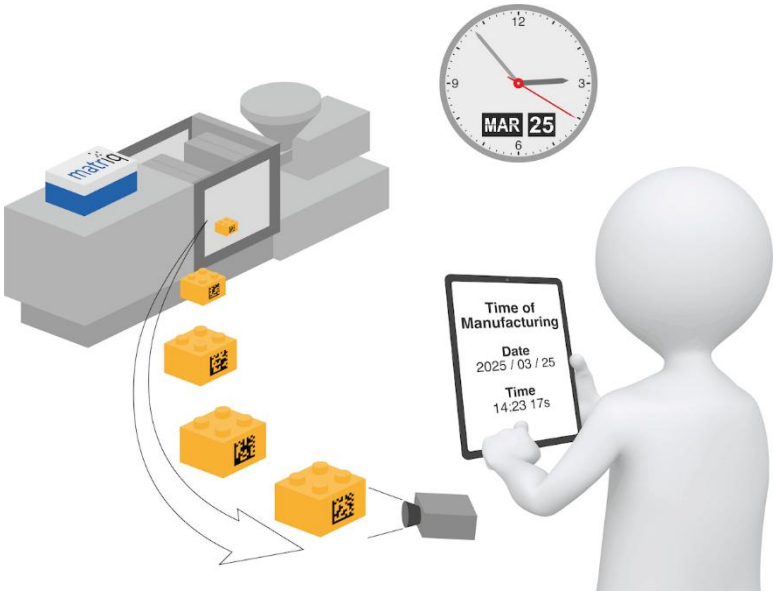
Case study: Serialization of products using a code number

Each produced part receives a unique part-specific code (number) applied during the molding process (see Generating Code). At the same time, the physical code is supplemented by an entry in the database at the production site (customer's IT system), which contains all available information from the machine and/or the existing measuring devices within the production cell. The machine or the SCADA system of the production cell handles the consolidation via OPC UA. Using a camera, for instance in an assembly line, all information may be retrieved and augmented by the following process steps.

Code management can be given to DM-qode system or assigned to, and maintained by, the customer. For OPC UA access, either as a server or as client, the DM-qode Gen1 system must be connected to the internal network.

Case study: writing a Unix Timestamp onto each part

The DM-qode Gen1 marks each produced part with a time stamp that holds the exact production time (year, month, day, hour, minute, second). This timestamp represents the number of seconds since January 1, 1970, and acts as a unique identifier for the part (equal to the MS Excel time format).



In parallel, the injection molding machine (IMM) stores data about the production cycle (called production protocol), including the cycle start time and cycle end time. The marked code is read by a code reader camera, to get the timestamp of that part. A database query is performed using the timestamp. The database returns the relevant cycle data for that part, helping to track when and how the part was produced.

It is strongly recommended to utilize an NTP server within the internal network to maintain precise timekeeping, avoiding clock drift and not affecting system accuracy and data integrity. Therefore, automated synchronization via NTP is the preferred approach to ensure consistent and reliable time management.

In multi cavity molds an additional engraved cavity number is useful, as all parts of one shot typically get the same time stamp.

Important considerations when using DM-qode Gen1

DM-qode Gen1 is designed for (internal) quality control, traceability, and to create a digital twin of every produced plastic part for injection molding and blow molding, assembling data from all process steps, material, mold, machine, etc.

The current version assigns a 10-digit data code to each part produced. Longer codes or “more” data would be required for certain applications. In the following, we summarize the high-lever aspects of product marking.

Regulated medical traceability codes (not yet supported by DM-qode)

For certain medical devices the MDR (Medical Device Regulation, EU 2017/745) has defined the traceability requirements. The central element of this is the Unique Device Identification (UDI) system, of which the UDI data needs to be entered into the European Database on Medical Devices (EUDAMED). The UDI is a system for the unique identification of medical devices. It consists of two parts: (i) UDI-DI (Device Identifier) is the static part, which identifies the manufacturer, model, and product family, and (ii) the UDI-PI (Production Identifier) is the dynamic part, which contains production data such as the batch number, expiration date, and serial number. This combination enables complete traceability of medical devices on the market.

The allocation bodies designated by the European Commission shall determine the exact format of the UDI codes. Since each issuing agency has its own standards, the length of the code varies depending on the system used. For example, GS1 uses the Global Trade Item Number (GTIN) for the UDI-DI, which has a standard length of 14 digits. The length of the dynamic UDI-PI is also variable.

Digital Product Passport (DPP) (not yet supported by DM-qode)

The digital product passport is a data set that can be accessed using a 2D-code. This code is affixed to each product and enables consumers, producers, or other stakeholders along the supply chain to access all relevant product- and material-related information. This information ranges from details about the carbon footprint to information on harmful ingredients and recycling and disposal options, as well as user manuals and instructions for use.

The digital product passport requirement (norm ISO/IEC 15459) will apply to all physical products, including components and intermediate products manufactured or put into service in the EU.

Product identification using GS1 (not yet supported by DM-qode)

GS1 is an international non-profit organization that develops and implements globally applicable standards for product identification and information management in the supply chain. GS1 uses the GTIN (Global Trade Item Number) as the static, identifying part that has a fixed number of digits, usually 13 digits (GTIN-13). It can be complemented with a dynamic number of 8 to 20 digits, depending on the desired/necessary content, such as serial and lot number, production date (6 digit) and expiry date (6 digit). And it can also be combined with a web link (URL).

Further reading:

(1) «Generate and read codes», matriq AG

(2) «Software instruction manual», matriq AG

(3) …